VERBAL AND NON-VERBAL THEORY OF MIND TASKS IN ADOLESCENTS WITH ASD

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Autism is a complex neurological disorder affecting individuals primarily in the areas of social interaction, communication and behaviors (Autism Society of Wisconsin, 2013). Autism spectrum disorders, commonly known as ASDs, are becoming more prevalent in today's society occurring in at least 1 in 88 individuals. Autism is considered a spectrum disorder which means the symptoms associated with this disorder can occur in any combination and with varying degrees of severity (Autism Society of Wisconsin, 2013). The three "autism spectrum disorders" are: Autistic Disorder, Asperger's Disorder, and Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS; Autism Society of Maine, 2013). [1]Symptoms of ASD vary from child to child but often fall into three areas: social impairment, communication difficulties, and repetitive or stereotypes behaviors (National Institute of Mental Health, 2013). Most children with ASD have trouble engaging in everyday social interactions, such as making eye contact or responding to other people when called upon. Likewise, individuals with an ASD may have trouble understanding another person's point of view. Communication difficulties such as the repetition of words or phrases, known as echolalia, or developing language at a delayed pace are often seen in individuals with an ASD. Repetitive arm flapping or walking in specific patterns can also be present (National Institute of Mental Health, 2013).

For the purposes of my study, I investigated ASD, more specifically those with high-functioning autism (HFA), as well as Asperger's disorder (AS) in relation to social interactions such as perspective taking incorporating theory of mind.

[1] The DSM-5 no longer includes Asperger's Disorder as a separate disorder on the autism spectrum. However, for the purposes of this study, I am going to use the criteria from DSM-IV in which Asperger's Disorder is a separate disorder on the autism spectrum.

Autism Spectrum Disorders

As previously stated, ASDs can be separated into three different disorders depending on the severity of symptoms experienced by the individual. HFA and AS are at the similar end of the ASD spectrum with symptoms being less severe than autistic disorder. For example, a person with HFA usually has average to above-average intelligence (Weintraub, 2013). AS and HFA belong to the category of pervasive developmental disorders (PDD), which are characterized by difficulties in social interaction, impairments in communication and language, and restricted and repetitive patterns of behavior (ICD-10, World Health Organisation, 1993). Although HFA and AS are at the similar end of the spectrum, they are not one in the same as AS does not display language delays as those with autism do. Despite this difference, HFA and AS are similar in their symptoms and overall functioning of the individual.

As previously stated, HFA and AS are characterized by difficulties in social interaction, impairments in communication and language, and restricted and repetitive patterns of behavior (ICD-10, World Health Organisation, 1993). This study focused on impairments associated with communication and language, specifically difficulties in pragmatic inferences, theory of mind, and perspective taking.

Pragmatic Inferences

Inferences are made when a person goes beyond available evidence to form a conclusion. A pragmatic inference is one in that is likely to be true because of the state of the world (Johnson-Laird, 1993). Definitions of pragmatics vary according to the theoretical background and focus of the study. However, regardless of differences in definition there is a consensus that utilization of context when inferring the meaning of an utterance belongs to the field of pragmatics, and that social and cognitive factors affect the pragmatic aspects of language

comprehension and expression (Loukusa & Moilanen, 2009). In other words, pragmatic competence allows an individual to speak intelligibly, behave appropriately, and most importantly, to understand the perspective of others (Lam & Yeung, 2012). Research has shown that pragmatic impairments are widespread in ASD. The language skills of individuals with AS and HFA are often within the normal range, and communication problems are mostly characterized by pragmatic aspects of language. Pragmatic differences are found in both children and adults with autistic disorder and AS, whereas formal language deficits (i.e. deficits in syntax, semantics, phonology) are not defining features of ASD and show a wide variability among persons with ASD (Pijnacker, Hagoort, Buitelaar, Teunisse & Geurts, 2009;Kjelgaard & Tager-Flusberg, 2001; Tager-Flusberg, 2006). Previous research indicates that high-functioning individuals with ASD have severe problems with pragmatic aspects of language as is shown by difficulty in understanding non-literal language. For example, people with ASD tend to interpret irony and metaphors literally and have difficulty understanding humor (Pijnacker et al., 2009). Happé (1993) found that there is a close link between pragmatic skills and theory of mind abilities. Theory of mind tasks are seen as a good predictor of understanding of non-literal uses of language like metaphors and irony. Therefore, pragmatic impairments in ASD are usually explained by an impaired theory of mind (Pijnacker et al., 2009; Baron-Cohen 1988; Tager-Flusberg 1999a, b).

Language ability has also been closely linked to the development of theory of mind. Language is important for the development of a consciously mediated explicit theory of mind (Tager-Flusberg, 2007). Despite the ability of some high-functioning children with autism to pass false-belief tasks, these children still lack social “intuition.” False-belief tasks are described as short tasks that assess theory of mind deficits and suggest a minimal level of ToM. Some

children with autism develop a linguistically mediated theory of mind that provides them with the facility to reason correctly about the social world, but their theory of mind is not based on the same foundational social insights that are provided by a domain-specific theory-of-mind mechanism (Tager-Flusberg, 2007). Therefore, individuals with HFA or AS may have a better understanding of perspective taking than others with autism spectrum disorders; however, they still lack the important aspect of social intuition, which occurs in everyday conversations.

Theory of Mind

Theory of mind, commonly referred to as ToM, refers to the ability to attribute mental states to self and others, including knowledge, beliefs, and intentions (Premack & Woodruff, 1978). The theory-of-mind hypothesis focuses on deficits in reasoning about mental states (Tager-Flusberg, 2007). Studies of children with ASD suggest that they treat ToM tasks as logical-reasoning problems, relying primarily on language and other nonsocial cognitive processes in lieu of social insight. Children with ASD generally have deficits in executive function skills that require planning, flexibility, or working memory combined with inhibitory control (Tagler-Flusberg, 2007; Ozonoff et al., 2004). Therefore, deficits in pragmatic inferences have a negative impact on ToM. Although once believed to be a monolithic process, with increased curiosity pertaining to ToM and its components, this concept is now being viewed as a multidimensional process. ToM is comprised of cognitive (cognitive ToM) as well as emotional aspects (affective ToM) (Sebastian et al., 2011). A recent model (Shamay-Tsoory, Harari, Aharon-Peretz, & Levkovitz, 2010; Figure 1) distinguishes cognitive from affective sub-processes of ToM (Sebastian et al., 2011)

Cognitive ToM Cognitive ToM refers to the ability to make inferences about other people's beliefs and motivations (Sebastian et al., 2011). Cognitive ToM is thought to require cognitive

understanding of the difference between the speaker's knowledge and that of the listener and is often assessed using false belief tasks (Kalbe et al., 2010). Cognitive ToM starts from the premise that mental states are not directly observable but have to be inferred and tends to place more emphasis on the ability to infer mental states such as beliefs, rather than emotions (Baron-Cohen, 1988). The cognitive theory proposes that the observed pragmatic deficits in ASD are those that would be expected if children with ASD are using language without a theory of mind (Baron-Cohen, 1988). For the current study, it was hypothesized that participants with HFA/AS will have large deficits compared to non-impaired controls in cognitive ToM.

Affective ToM Affective ToM refers to the ability to infer what a person is feeling (Sebastian et al., 2011). According to Figure 1, cognitive ToM is a precursor for affective ToM and requires intact empathy processing. Therefore, a successful affective ToM processing requires the integration of cognitive ToM and empathy (Sebastian et al., 2011). The current study hypothesized that participants with HFA/AS will do significantly worse on affective ToM tasks than non-impaired participants. Research has shown that individuals with ASD have trouble expressing emotion and being able to feel what another person is feeling.

Empathy Empathy is an important ability that allows us to tune in to how someone else is feeling, or what they might be thinking. Empathy allows us to understand the intensions of others, predict their behavior, and experience an emotion triggered by their emotion. Overall, empathy is the "glue" of the social world (Baron-Cohen & Wheelwright, 2004). As Figure 1 shows, empathy is necessary for both cognitive and affective ToM. Cognitive ToM is closely related to cognitive empathy (perspective taking) while affective ToM is linked to affective empathy (emotion recognition/expression; Mathersul, McDonald & Rushby, 2013).

ToM can be broken into cognitive or affective components and as Figure 1 shows, a basis of empathy is required (Sebastian et al., 2011). Another communicative difficulty associated with HFA and AS is perspective taking which requires the implementation of empathy as well as interpretation of mental states of others.

Perspective Taking

Perspective taking is defined as the ability of an individual to interpret his/her emotional and mental states and those of others. This ability implies the capacity to distinguish what individuals know about themselves in a certain situation (how someone thinks, feels, and behaves) and what they know of other individuals in the same situation (Nickerson 1999; Ziv & Frye, 2003). This ability is conceptualized as metacognition and it is assumed that the object of study is the theory of mind. Results of past research on theory of mind have reported that children diagnosed with ASD do not appropriately interpret emotions, thoughts, or social behaviors of others and sometimes themselves. As indicated by the research of Howlin, Baron-Cohen, & Hadwin (1999), perspective taking is thought to include five levels: (a) simple visual perspective taking, (b) knowledge that different individuals can separately have the same thoughts, (c) understanding that "seeing leads to learning" followed by (d) the ability to predict actions based on valid beliefs, and finally (e) the ability to predict false beliefs. Under the research of Howlin et al., (1999), many individuals with ASD would not be able to perform perspective taking activities because they would not be able to successfully perform each level involved in perspective taking as described above. However those with HFA or AS may be able to successfully perform each level involved in perspective taking and use their concept of theory of mind to assist in false belief tasks.

Minimal research has been performed on perspective taking in individuals with ASD and even more rare, the distinction between affective and cognitive theory of mind. Therefore, the main purpose of this study was to investigate whether individuals with HFA or AS disorder are capable of understanding perspective taking. Pragmatic interpretation involves the attribution of intentions and beliefs to other people. Furthermore, it requires reasoning about other people's beliefs, and it is precisely this "mindreading" or incorporation of ToM, that has been shown to be difficult for people with ASD (Pijnacker et al., 2009; Baron-Cohen, 1995, 2001).

Method

Participants

Twenty-seven adolescents ages 11-17 were recruited for my study. Thirteen adolescents were recruited from the Independence Academy of Indiana in Indianapolis (Female = 1; Male = 13). The Independence Academy serves middle school, junior high and high school students with high-functioning autism and Asperger Syndrome (The Independence Academy of Indiana). Life and social skills development is incorporated in all classes throughout the day in addition to a daily life skills class. Students participate in monthly field trips where life and social skills are put to practical use (The Independence Academy of Indiana). Individuals with an ASD diagnosis were matched with fourteen non-impaired adolescents recruited from Burris Laboratory School in Muncie, Indiana (Female = 9; Male = 4).

Materials

Kaufman Brief Intelligence Test Second Edition (KBIT-2)

The KBIT-2 is a brief measure of verbal and non-verbal intelligence and was used to assess that the participants were of at least normal intelligence. In two separate studies involving children and adolescents, the KBIT-2 was administered along with either the WISC-III or the WISC-IV and the mean KBIT-2 scores were within 2 points of mean scores on the WISC-IV

(Kaufman & Kaufman, 2004). Therefore, the KBIT-2 is a valid assessment that yields relatively exact mean scores as the WISC-IV with a shorter administration time. The KBIT-2 has a test-retest reliability of .92 for IQ composite scores and .90 and .86 test-retest reliability for verbal and non-verbal components (Kaufman & Kaufman, 2004). The KBIT-2 was chosen to decrease the amount of time to complete the study.

Theory of Mind Cartoon Vignette

The cartoon vignette paradigm by Sebastian et al., 2011 (adapted from Vollm et al., 2006) was the non-verbal ToM task implemented in my study. The stimuli consist of 30 cartoons divided into three conditions of ten cartoons each: Affective ToM, Cognitive ToM, and Physical Causality. For Affective ToM cartoons, participants were required to infer how one story character would react to their companion's affective state, and choose the correct ending (Sebastian et al., 2011). For Cognitive ToM cartoons, participants were required to make an inference based on the intentions or beliefs of one story character and their companion, and are instructed to choose the correct ending. Lastly, the Physical Causality scenarios require an understanding of cause and effect, and do not require the understanding of mental states; thus, this is a control condition (Sebastian et al., 2011). For all three conditions participants were given two endings, cartoon A or cartoon B, in which they must deliberate between the two and decide which cartoon best fits the ending for that vignette. The task was piloted on children of the target age group (10-16 years) for both clarity of the stories and the appropriateness of the timings (Sebastian et al., 2011).

Faux Pas Recognition

Faux pas stories were verbal ToM stimuli given to adolescents with ASD (N=13) and to a non-impaired control group (N=14). Ten faux pas stories were used for this study (Baron-Cohen

et al., 1999). A faux pas occurs when a speaker says something without considering if it is something that the listener might not want to hear or know, and typically has negative consequences that the speaker never intended (Baron-Cohen et al., 1999). Faux pas stories are used to assess both cognitive and affective components of ToM (Poletti, Enrici & Adenzato, 2012). Each story involves two or three characters and at least two separate statements. The language of the stories is simple enough so that adolescents will not have trouble with the content. The stories were designed so that the faux pas occurred either in the last phase, one phrase before last, or two phrases before the end. This was to ensure that the participant could not pass by simply quoting the last phrase heard (parroting) or using some similar strategy (Baron-Cohen et al., 1999). The scoring for the faux pas stories were all or nothing. Therefore, if the participant did not answer the first question correctly, the experimenter went on to the next question and they were assigned a score of zero for that question. The highest score a participant could achieve on all faux pas stories was a score of 10. All stories were recorded onto a CD and played for the participant on my computer to avoid the possibility of facial expressions giving feedback to the participant.

After each story, the subject was asked four questions (See Appendix A). Asking whether anyone in the story said anything that they should not have said and asking what should not have been said assessed affective and cognitive ToM respectively (Poletti et al., 2012). If the child answered the first question incorrectly in each story set, the second question was not asked.

Wide Range Achievement Test (WRAT4)

The Wide Range Achievement Test (WRAT4) is a widely respected assessment that accurately measures the basic academic skills of word reading, sentence comprehension, spelling, and math computation. The WRAT4 serves as a psychometrically sound assessment of

a student's fundamental academic skills and serves as an excellent initial evaluation especially those referred for learning, behavioral, or vocational difficulties (Wilkinson & Robertson, 2012). For the purposes of my study, I used the Word Reading and Sentence Comprehension measure to ensure that the participant had a sufficient reading level to understand the faux pas stories. The Word Reading measures letter and word decoding through letter identification and word recognition while the Sentence Comprehension measures an individual's ability to gain meaning from words and to comprehend ideas and information in sentences using a modified cloze technique (Wilkinson & Robertson, 2012). A Reading Composite score was then derived by combining the Word Reading and Sentence Comprehension standard scores.

The WRAT4 was based off a national standardization sample of 3000. The sample included student with disabilities (5%), and has an internal consistency of .87 to .96 for subtests and composites for both grade and age (Wilkinson & Robertson, 2012). Test-retest reliability for the Word Reading measure was .86 while the Sentence Comprehension measure was .78. The time interval between testing was within one month.

Procedure

Participants entered the classroom individually, were greeted, and asked to sit in a seat of their choosing. A letter of informed consent (Appendix B) was previously sent home to the parents and they agreed for their child to participate. Careful examination and explanation of the informed consent was implemented before beginning the study to ensure that the participant understood all aspects of the study at hand. The study began with the administration of either the faux pas stories or the cartoon vignettes. These were counterbalanced between subjects. After the administration of either the non-verbal or verbal stimuli, participants were asked whether they needed a break or if they were ready to continue. If a break was desired, the participant was told

they could get up and walk around the classroom or relax for five minutes before beginning again. Next, the remaining stimuli were administered, either the verbal or non-verbal, depending on the previous order. The faux stories were introduced by saying, " Now I'm going to play you some stories. I want you to listen very carefully because afterwards I am going to ask you some questions to see what you think of them. Are you ready?" A sample question was played to control for volume and make sure that the participant had a general idea of the task at hand. The CD was paused after each story and the questions from Appendix A were asked. The cartoon vignettes were then administered by giving participants a sheet of paper numbered one to thirty with answer choices of either A or B. The participants watched each vignette and circled either A or B, whichever they feel was the correct ending to the cartoon. The order in which the cartoons were presented as well as the order of the three conditions was randomized for each participant. The cartoons were presented on a laptop in sets of 6 cartoons and between each set a blank screen was displayed for 15 seconds (Sebastian et al., 2011). Each trial started with an instruction screen displayed for 5 seconds reading, "What happens next?" This was followed by the three story frames each presented for 2 seconds leading to the choice of endings being displayed for 5 seconds (Sebastian et al., 2011). The participant then circled either A or B on their paper in correspondence to the appropriate ending they chose as their answer.

After completion of the verbal and non-verbal stimuli tasks, the KBIT-2 and WRAT4 were administered. Upon completion, the participant was thanked for their participation and compensation was given to the school director, who in turn gave the compensation to the parent of the child for participating. They were asked if they have any questions or concerns about any aspect of the study. After questions and concerns were addressed they were free to leave. The study took about 45 minutes to an hour to complete per participant.

Results

Sample Characteristics.

Table 1 depicts the overall description of my sample in regard to age, gender, IQ score, reading comprehension, and verbal ToM task. Participants from the Independence Academy were of male majority and had a mean age of 13.79 years old. The mean score on all components of the KBIT-2 IQ assessment (total IQ, non-verbal IQ, verbal IQ) were in normal range as well as the WRAT4. The mean score for both the KBIT-2 ad WRAT4 for the normal population is 100. Participants from Burris Laboratory School were of female majority and had a mean age of 13.77 years old. Participants from Burris obtained a mean score of average on all components of the KBIT-2 and above average on the WRAT4. It is evident from the sample that gender was not equally distributed between the two schools and this could have an effect on the data as more males were assessed from the Independence Academy and more females from Burris. As research shows, autism is five times more prevalent in boys (1:42) than girls (1:89) (Autism Society of Maine, 2013).

{Insert Table 1}

Differences between ASD and non-impaired participants were not significant for IQ (KBIT-2, p =.309) or reading comprehension (WRAT, p = .179). Therefore, there were no significant differences in IQ score and reading comprehension among groups. This non-significance shows that participants were matched in regard to IQ scores as well as reading comprehension and no significant differences among groups were found. Differences between ASD and non-impaired participants were not significant for verbal ToM (faux pas stories, p = .269) or non-verbal ToM (cartoon vignettes, p = .160).

A demographics questionnaire was filled out by parents in which they stated what medications, if any, their child was taking while participating in the study. Of the 14 participants from the Independence Academy, 10 were taking medication while participating in the study. Of the 13 participants from Burris, 4 were taking medication. I ruled out medications such as over-the-counter stomach medicines (i.e. Prilosec), allergy medications (i.e. Zyrtec, Claritin), and inhalers for asthma (i.e. Pro-Air). It's unlikely that these medications would have had a significant effect on the participant's performance and were not pertinent to the study or findings. Of the four participants at Burris taking medication during the study, one was prescribed a medication for symptoms of depression and obsessive-compulsive tendencies. The other three participants were taking over-the-counter drugs that I did not classify as relevant. Of the 10 participants from the Independence Academy that were on medication during the study, each participant was on some sort of mood stabilizer, anti-depressant, or attention deficit-hyperactivity medication. This drastic difference between groups in medication usage should be taken into consideration when interpreting results and findings.

Primary Analyses.

A 2 X 3 ANOVA (Group X Type of ToM) with repeated measures on ToM was run in order to determine whether there was a difference in affective and cognitive ToM in non-verbal tasks. Physical causality was included as a control condition as these scenarios did not require an understanding of mental states as do affective and cognitive ToM (Sebastian et al., 2011). In regard to type of ToM (i.e. affective, cognitive, physical causality) there was not a significant main effect, $\underline{F}(2, 50) = 2.800$, $p = .085$. A significant interaction was found between ToM type and group, $\underline{F}(1.55, 38.83) = 3.344$, $p < .05$. Thus, there was a moderate effect of an ASD diagnosis versus no ASD diagnosis on achievement in certain cartoon categories. Table 2

displays the mean and standard deviation of cartoon type and impaired versus non-impaired participants.

{Insert Table 2}

It was hypothesized that adolescents with HFA/AS would have a deficit in affective ToM with both the verbal and non-verbal stimuli compared to their non-impaired controls. As can be seen in Table 2, there were no significant differences in cognitive or affective non-verbal ToM tasks between ASD and non-impaired participants, $p = 0.65$. However, a significant difference was found in the physical causality ToM control condition, $p = .022$. Participants with an ASD diagnosis did significantly worse on identifying the proper ending of a physical causality scenario cartoon as opposed to their non-impaired participants.

Exploratory Analyses.

Although no predictions were made in this regard, exploratory analyses were conducted in order to examine the possible different relationships between the various ToM tasks as well as the relationship between ToM tasks and other measures of intellectual functioning. In participants diagnosed with ASD, IQ total was not correlated with affective ToM scores, $r = -.017$, or cognitive ToM scores, $r = .238$. However, in non-impaired participants, a strong correlation exists between IQ and affective ToM scores, $r = .614$, but not for cognitive ToM scores, $r = .287$. Hence, affective perspective taking was related to overall intelligence for non-impaired participants. However, for those with ASD, variables other than IQ drive affective perspective taking.

In addition, cognitive ToM and affective ToM were highly correlated for non-impaired participants, $r = .808$, but not for participants with ASD, $r = -.347$. Similarly, affective ToM and physical causality were highly correlated for non-impaired participants, $r = .686$, but not for

participants with ASD, r = -.188. Hence, for non-impaired participants, performance on each of the three ToM scales was highly correlated, a pattern that did not occur for participants with ASD.

Scores on the KBIT-2 show an overall IQ score, as well as a verbal and non-verbal IQ score. Because my study examined both verbal and non-verbal tasks in their relation to different aspects of ToM, how the verbal and non-verbal aspects of my study correlated with verbal and non-verbal IQ was of interest. In non-impaired participants, scores were highly correlated for faux pas story totals (verbal ToM) and verbal IQ score, r = .647, but not for participants with an ASD diagnosis, r = .298. However, in non-impaired participants, scores were not correlated for cartoon vignettes (non-verbal ToM) and non-verbal IQ score, r = .189, but were for participants with an ASD diagnosis, r = .600. In conclusion, in participants with an ASD diagnosis, non-verbal IQ was highly correlated and in non-impaired participants verbal IQ was highly correlated.

Discussion

The present study aimed to assess the different components of verbal and non-verbal ToM tasks in adolescents with HFA/AS compared to a non-impaired group. Contrary to the primary hypothesis, there were no significant differences in adolescents with HFA/AS and non-impaired controls in their performance on verbal or non-verbal ToM tasks.

The type of ToM cartoon (i.e. affective, cognitive, physical causality) in relation to group (ASD versus non-impaired) showed that there was a moderate effect of an ASD diagnosis versus no ASD diagnosis on achievement in certain cartoon categories. Although there were no significant differences found, participants with an ASD diagnosis did worse on certain ToM

cartoon categories compared to their non-impaired peers, specifically in the control (physical causality) condition.

In relation to verbal ToM tasks such as faux pas stories, previous research has shown a significant difference between participants with HFA/AS and non-impaired participants (Baron-Cohen et al., 1999). The present study yielded non-significant differences in verbal ToM tasks and hence does not support my hypothesis that individuals with HFA/AS would have a deficit in verbal ToM compared to non-impaired participants. Variables such as IQ, reading comprehension, and facial or vocal expressions given by the experimenter were controlled during this study. Happé (1993) found that there is a close link between pragmatic skills and theory of mind abilities. In general, theory of mind tasks were a good predictor of understanding non-literal uses of language like metaphors and irony. Therefore, pragmatic impairments in ASD are usually explained by an impaired theory of mind (Pijnacker et al., 2009; Baron-Cohen 1988; Tager-Flusberg 1999a, b). Pertaining to the results of my study, something other than theory of mind is playing a role in pragmatic impairments in the ASD population. At the Independence Academy of Indiana, life and social skills development is incorporated into all classes throughout the day and are seen as important to the growth and development of the individuals. Students are encouraged to interact with one another throughout the day and take part in group activities. The highly structured life and social skills training provided by the Independence Academy along with academic material may have had a positive effect on the participants ToM, leading to the non-significant results between groups.

In non-verbal ToM tasks such as cartoon vignettes, it was hypothesized that significant differences would be found in affective ToM between groups. The present study yielded non-significant differences between ASD and non-impaired participants pertaining to affective ToM

scores. Therefore, ASD and non-impaired participants did equally well on identifying affective ToM states in cartoon vignettes. Previous research shows that non-significant group differences between those with ASD and a non-impaired control group on non-verbal ToM tasks have been found (Loukusa, Makinen, Kuusikko-Gauffin, Ebeling, Moilanen, 2014). Although previous studies have used differing materials, the overall conclusion of non-significant results remains the same. Because affective ToM refers to the ability to infer what a person is feeling (Sebastian et al., 2011), it was hypothesized that participants with ASD would have more difficulty than their non-impaired matched peers. Results of past research on ToM have reported that children diagnosed with autism do not appropriately interpret emotions, thoughts, or social behaviors of others and sometimes themselves (Gómez-Becerra, Martín, Chávez-Brown, & Greer, 2007). Per the results of the study, participants with ASD performed equally well on identifying emotions and thoughts of others (i.e. those in cartoon vignettes). Therefore, variables other than an ASD diagnosis played a role in identifying affective states of others. As previously stated, the Independence Academy incorporated life and social skills into their academic curriculum resulting in the practice of these skills on a daily basis. Therefore, an ASD diagnosis may not play a significant role in identifying affective states of others with the implementation of life and social skills on a daily basis. Pertaining to the physical causality control condition, there was a significant difference between groups with non-impaired participants performing significantly better than their peers with an ASD diagnosis. The physical causality condition required an understanding of cause and effect, and do not require the understanding of mental states; thus, was used as a control condition (Sebastian et al., 2011). Because participants with an ASD diagnosis performed significantly worse than their non-impaired peers on the physical causality condition that did not require the understanding of mental states but instead a cause and effect

relationship, this may suggest that individuals with ASD have a deficit in identifying cause and effect relationships. Furthermore, individuals with ASD may have a more difficult time than their non-impaired peers in identifying what will come next in a situation rather than identifying their mental states.

Although there were no significant differences between groups in relation to verbal and nonverbal ToM tasks, different relationships between the various ToM tasks as well as the relationship between ToM tasks and other measures of intellectual functioning were found.

In regard to non-impaired participants, overall intelligence was related to affective perspective taking or the ability to infer what a person is feeling. However, for those with ASD, overall intelligence was not related to affective ToM suggesting that variables other than IQ drive affective perspective taking in this population. Therefore, what variables are associated with affective perspective taking and participants with ASD? Sebastian et al (2011) state that cognitive ToM is a precursor for affective ToM and requires intact empathy processing. Therefore, successful affective ToM processing requires the integration of cognitive ToM and empathy. In regard to ASD participants, empathy and cognitive ToM could play a role in their affective perspective taking skills.

In non-impaired participants, all three components of non-verbal ToM tasks were highly correlated, a pattern that did not occur for participants with ASD. Therefore, for participants with ASD their scores on the three components were not related to one another and varied among one another. However, for non-impaired participants, there was a strong correlation between the components suggesting that when one component would increase another would as well.

Overall, the present study aimed to achieve significant differences between groups in verbal and non-verbal ToM tasks. However, a significant difference between groups was not

found between verbal and non-verbal ToM tasks. Interestingly, the physical causality control condition for non-verbal ToM yielded significant differences between groups with the non-impaired participants performing significantly better than participants with an ASD diagnosis. The study found an interesting correlation between total IQ score and non-verbal affective ToM scores in non-impaired but not in ASD participants suggesting variables other than IQ are influencing affective perspective taking in individuals with ASD. Because autism is a spectrum disorder, individuals vary greatly in their ability to communicate, both verbal and non-verbal, and the way in which they interact with others (Autism Society of Maine, 2013). Therefore, variables such as social interaction, or an individual being less responsive to social cues such as eye contact or smiles, may play a role in affective perspective taking (Autism Society of Maine, 2013). Because individuals with ASD tend to display deficits in social interaction, these deficits may be playing a role in affective perspective taking.

Limitations

There were several limitations in the present study that should be taken into consideration when interpreting the results. The present study assessed participants from the Independence Academy and Burris Laboratory School. Participants from the Independence Academy were predominately male (13:1), while participants from Burris Laboratory were predominately female (9:4). Therefore, a gender effect could have taken place due to the vast difference in samples in regards to gender. Participants diagnosed with ASD in this study were of average intelligence and had an average reading comprehension level. Therefore, the results from this study cannot be generalized to ASD populations with below average intelligence or below average reading comprehension levels. The ceiling effect that occurred on the ToM tasks is a major concern in the present study. All participants, with and without an ASD diagnosis, did well

on all ToM tasks, which led to little variability that could have masked group differences. Because the non-verbal ToM tasks had two choice endings, the participant had a 50/50 chance of obtaining the correct answer by simply guessing. Therefore, non-verbal ToM tasks were not especially accurate at determining ToM in participants. The sample size of the present study is another concern. Many of the past research studies have sample sizes of 20-30 participants per group while my study had 14 with ASD and 13 non-impaired participants. Therefore, significance could have been achieved had a larger sample size been utilized. Given that all students at the Independence Academy that met the criteria participated in the research study, obtaining a larger sample size was not realistic given the available subject pool. Lastly, there are few studies on nonverbal ToM tasks, specifically utilizing cartoon vignettes, in which the participant must choose the appropriate ending. A plethora of ToM research uses tasks such as the Sally-Anne task, False-belief task, or Strange Story task, to identify ToM deficits in ASD participants. Therefore, results obtained from the present study should take the following limitations in consideration until further replication is provided.

Future Research

Future studies should attempt to obtain a more standardized sample in regard to gender for ASD and non-impaired participants. I believe that the vast gender difference between samples had an effect on the overall results of the study. Because the ASD sample was predominately male and non-impaired sample was predominately female, gender effects occurred and could have been decreased had an equal number of each gender participated. Future research is needed to determine what underlying variables influence affective perspective taking individuals with ASD.

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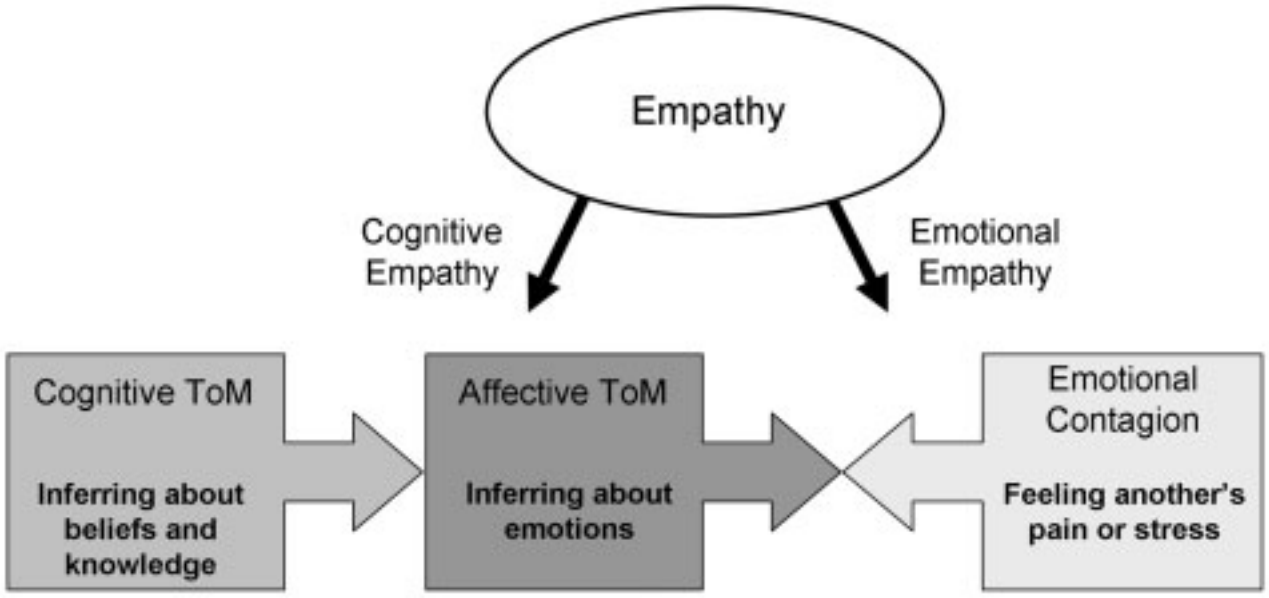

Figure 1. The model of the relationship between cognitive ToM, affective ToM and empathy proposed by Shamay-Tsoory et al. (2010). Cognitive ToM is a prerequisite for affective ToM, which also requires cognitive and emotional (or affective) aspects of empathy. Figure adapted with author's permission.

Appendix A

Question 1: Did someone say something they should not have said? (affective ToM)

Question 2: What should not have been said? (cognitive ToM)

Question 3:Who won the story competition? (comprehension question)

Question 4: Did Alice realize that Emma hadn't heard the results of the competition? (False-belief)

Appendix B

CONSENT FORM

Verbal and Non-verbal Theory of Mind Tasks in Adolescents with ASD

Purpose of Study
The purpose of this study is to further investigate theory of mind deficits in adolescents with autism spectrum disorders (ASD). Previous research has shown that individuals with ASD have deficits in theory of mind as well as perspective taking in everyday conversations. The present study will attempt to extend this research by dividing theory of mind tasks into verbal and non-verbal tasks as well as separating components of theory of mind into affective and cognitive components to determine whether a significant difference occurs. We are recruiting non-ASD students from Burris Laboratory School to serve as a control group.

Inclusion/Exclusion Criteria
For your child to participate in this study they must be between the ages of 11-17 and English must be their first and primary language. Participants are being recruited from Burris Laboratory School.

Participation Procedure and Duration
If you and your child choose to participate, you will complete a demographics questionnaire for your child about your child's age, grade, ethnicity, diagnoses, etc. Two theory of mind tasks, a brief standardized intelligence measure (KBIT-2), as well as the reading comprehension subtest of the Wide Range Achievement Test (WRAT-4) will be completed by your child. Two theory of mind tasks will be administered. One task consists of answering questions about stories read to your child. The second task consists of your child looking at cartoons and choosing the appropriate ending cartoon to complete the story. The Kaufman Brief Intelligence Test, second edition (KBIT-2) is a brief standardized assessment of intelligence that will take approximately twenty minutes to complete. Lastly, the Wide Range Achievement Test (WRAT-4) reading comprehension subtest will assess your child's reading comprehension level. The full participation time will be approximately 45 minutes to an hour. At any time during the study you, the parent/guardian, can withdraw your child from participating for any reason without penalty or prejudice from the investigator.

Data Anonymity
All information obtained during your child's participation will be anonymous. This means that no personally identifiable information will be associated with your child's data, and there will be no way of identifying your child's identity from the data obtained. Your signed informed consent will be kept separate from your responses.

Data Storage
All data from the Demographics questionnaire, KBIT-2 and WRAT-4 protocol, provided answers on the verbal and non-verbal theory of mind tasks, and informed consent will be stored in a locked file cabinet. All data will also be password protected on the principal investigator's

laptop. This locked file will only be accessible to those directly involved in the study. All data will be destroyed two years upon completion of my thesis.

Risk or Discomforts
There are no anticipated risks of your child participating in this study.

Benefits
There is no direct benefit to your child for participating in this study. However, the results will contribute to our understanding of theory of mind difficulties in adolescents with high-functioning autism or Asperger's disorder.

Compensation
Participants will receive $10.00 compensation for their time. Monetary compensation is optional and those who choose not to accept it may still participate. Because your children are minors, the $10.00 will be given to the parent/guardian.

Voluntary Participation
Your child's participation in this study is completely voluntary and your child is free to withdraw their permission at anytime for any reason without penalty or prejudice from the investigator. Please feel free to ask any questions of the investigator before signing this form and at any time during the study.

IRB Contact Information
For questions about your child's rights as a research subject, please contact Director, Office of Research Compliance, Ball State University, Muncie, IN 47306, (765) 285-5070, irb@bsu.edu

If you would like any further information please contact the primary investigator at ajhenderson@bsu.edu.

Consent

I, _____, agree for my child, _____, to participate in this research project entitled, "Verbal and Non-verbal Theory of Mind Tasks in Adolescents with ASD." I understand that participation is voluntary and my child is free to decline to participate in this research study, or I may withdraw their participation at any point without penalty. The study and all of my questions have been answered to my satisfaction. If I have any further questions abut the study, I can contact Amanda Henderson or Dr. Holtgraves, Chair of committee. I have read the description of this project and give my child consent to participate. I understand that I will receive a copy of this informed consent form to keep for future reference.

Student is a minor _____
(age)

Parent/Guardian: _____
(signature)

Date:_____

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Table 1

Demographics of Participants

Variable	ASD	Non-ASD	*t*
Gender	M= 13 F= 1	M= 4 F= 9	N/A
Age	M= 13.79 SD= 1.311	M= 13.77 SD= 2.048	.025
IQ Total	M= 96.57 SD= 20.709	M= 103.00 SD= 9.600	-1.047
Non-verbal IQ	M= 94.50 SD= 18.480	M= 100.92 SD= 12.939	-1.052
Verbal IQ	M= 99.14 SD= 19.876	M= 103.38 SD= 7.730	-.740
WRAT	M= 104.57 SD= 21.582	M= 113.77 SD= 11.584	-1.393

Table 2

Mean and standard deviation of ASD and non-ASD participants in ToM Tasks

Variable	ASD	Non-ASD	*t*
Affective ToM	M = 9.29 SD = .914	M = 9.46 SD = .877	-.510
Cognitive ToM	M = 8.93 SD = 1.385	M = 9.46 SD = .660	-1.166
Physical Causality	M = 7.43 SD = 3.005	M = 9.54 SD = .660	-2.561*
Total non-verbal ToM	M = 26.57 SD = 4.219	M = 28.46 SD = 2.295	-1.460
Verbal ToM (faux pas)	M = 6.50 SD = 2.103	M= 7.46 SD = 2.295	-1.132

Note: *p < .05